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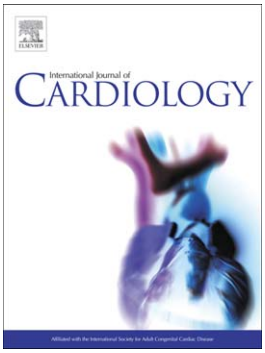

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Return to the Workforce Following Coronary Artery Bypass Grafting: a Danish Nationwide Cohort Study

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Key words:
Epidemiology; coronary artery disease; coronary artery bypass grafting; workforce attachment.

Abstract

Background: To examine return to the workforce and associated factors in patients of working age undergoing coronary artery bypass grafting (CABG).

Methods and Results: Using Danish nationwide administrative registries, we identified 6031 patients of working age (18-60 years) undergoing isolated CABG (1998-2011) who were part of the workforce 30 days prior to admission and alive at discharge. One year after discharge for CABG, 4827 (80.0%) patients had returned to the workforce, 614 (10.2%) were on paid sick leave, 267 (4.4%) received disability pension, 250 (4.1%) were on early retirement, 57 (0.9%) had died, and 16 (0.3%) had emigrated. Factors associated with return to the workforce were identified using multivariable logistic regression. Younger age (18-45 versus 56-60 years; odds ratio, 1.89; 95% confidence interval, 1.48-2.42), male sex (1.51, 1.24-1.84), and higher level of education (higher educational level versus basic school; 1.53, 1.05-2.23) and income (highest quartile versus lowest; 3.01, 2.42-3.75) were associated with return to the workforce. Urgency of surgery (emergency versus elective; 0.65, 0.49-0.88), cardiovascular comorbidity, a history of chronic kidney disease (0.49, 0.29-0.84) and liver disease (0.47, 0.28-0.80), as well as additional hospital admissions within the first year post-discharge (>2 versus none; 0.25, 0.19-0.32) were associated with a lower likelihood of returning to the workforce.

Conclusion: One year after discharge for CABG, four out of five patients were part of the workforce and mortality was low. Younger age, male sex, higher socioeconomic status, and absence of major comorbidities were associated with return to the workforce.

Key words: Epidemiology; coronary artery disease; coronary artery bypass grafting; workforce attachment.

Introduction

Over the last decades, survival following coronary artery bypass grafting (CABG) has greatly improved.(1-3) However, traditional outcome measures, such as mortality, morbidity, and serious adverse events do not provide a complete assessment of the consequences of the procedure and the underlying disease for the individual patient. A more comprehensive assessment should include living capabilities at home, at work, or in the society.(4-6) Attention should also be paid to other measures indicating a successful surgery and recovery, namely functional rehabilitation and postoperative quality of life such as return to work. Employment is important for physical and mental health, self-esteem, self-confidence, and social identity and provides financial independence and economic contribution to the society.(7-11) The ability to return to work after CABG holds important socioeconomic consequences not only for patients, but the society as well. It is therefore of great importance to identify patients at high risk of workforce detachment after surgery and potentially enhance current cardiac rehabilitation guidelines. Prior studies examining this relationship reported differing rates of returning to work after CABG and were limited by small number of patients.**(12-20)** To address these issues, we conducted a Danish nationwide retrospective cohort study to examine return to the workforce and associated factors in patients of working age undergoing isolated CABG.

Methods

The Danish healthcare and social welfare systems

The Danish healthcare system, funded by taxes, provides free and equal access to healthcare for all residents regardless of employment status. Likewise, social welfare benefits and social services, also financed by taxes, are provided to residents whenever indicated. These benefits include, but are not limited to, state educational grants, unemployment benefits, and disability pension. In Denmark, all

residents are offered a fully state-funded pension at the age of 65 or later depending on the date of birth.

Data sources

All residents in Denmark are assigned a unique and permanent civil registration number which enables accurate linkage of nationwide administrative registries at an individual level. The Danish registry on all public welfare benefits holds information on all Danish residents who have received public welfare benefits at any time on a weekly basis since 1991. The Danish National Patient Registry contains information on all hospital admissions since 1977 and all surgical procedures since 1996. Each admission is registered by one primary diagnosis and, if appropriate, one or more secondary diagnosis according to the International Classification of Diseases (ICD-8 until 1993 and ICD-10 from 1994). All surgical procedures, registered according to the NOMESCO Classification of Surgical Procedures (NCSP) used in Nordic countries, are registered by one or more codes depending on the type and scale of the operation.**(21)** The Danish National Prescription Registry holds detailed information on dispensing date, strength, and quantity on all claimed drug prescriptions dispensed from pharmacies in Denmark.**(22)** Information on vital status was attained from the Danish National Population Registry,**(23)** and data on education and household income was obtained from the Statistics Denmark.**(24, 25)**

Study population

We identified all Danish residents undergoing first-time isolated CABG (NCSP codes KFNA-KFNE) between January 1, 1998 and December 31, 2011. In order to investigate return to the workforce, only patients of working age between 18 and 60 years, who were part of the workforce

30 days prior to admission and alive at discharge after CABG were included and comprised the study population.

Study covariates

Urgency of CABG was classified as elective, urgent (defined as surgery performed during the hospitalization period for acute myocardial infarction (AMI)), or emergency surgery (defined as surgery within 24 h after admission for AMI or surgery on the same day as percutaneous coronary intervention (PCI)). Comorbidity was obtained through the Danish National Patient Registry using hospital discharge diagnoses any time prior to and including index hospitalization for CABG (Supplementary Table 1 for ICD-8 and ICD-10 codes). Patients with diabetes and hypertension were identified using claimed drug prescriptions as done previously.**(26, 27)** In addition, Charlson Comorbidity Index was calculated as described previously to quantify the burden of comorbidities (Supplementary Table 2 for the weight of each comorbidity).**(28)** Patients with a Charlson Comorbidity Index greater than 2 were considered as having significant comorbidities. Concomitant pharmacotherapy was defined through the Danish National Prescription Registry as claimed prescriptions within 180 days prior to admission for CABG (Supplementary Table 3 for ATC codes). The highest level of completed education prior to admission for CABG was classified in accordance with the International Standard Classification of Education (i.e. basic school, high school, vocational education, short/medium length higher education, and long higher education or research). Average 5-year household income was calculated and graded in quartiles.

Workforce attachment

Patients were classified as part of the workforce if they were employed, unemployed but capable of working (i.e. not receiving paid sick leave or disability pension or not on early retirement), or

received state educational grants, paid maternity leave, or other leave of absence. Employment status 30 days prior to admission for CABG was determined based on the five weeks leading up to this date, and only patients who were part of the workforce were included in the study. Five-week evaluation periods were applied in order to reduce misclassification, i.e. to ensure that patients with short-term sick leave were not classified as detached from the workforce – a method described previously.**(29, 30)** Therefore, only patients with sick leave of at least three out of the five evaluated weeks were classified as detached from the workforce. No patients could by our design reach the state pension age during our follow-up period. Further, it was possible for patients to change status (i.e. attachment or detachment from the workforce) at later evaluations during follow-up.

Outcomes

Outcomes, i.e. part of the workforce, detached from the workforce, and death, were assessed every 6 months for a total of two years after discharge for CABG. Our primary endpoint was return to the workforce estimated in the five-week period one year after CABG. In addition, we calculated time to return to the workforce defined as a minimum of three consecutive weeks at any time during a two-year follow-up period. Among patients who returned to the workforce for at least three consecutive weeks, we evaluated maintenance of workforce attachment during a two-year follow-up period by estimating time to one, three, and 12 weeks of consecutive detachment.

Sensitivity analysis

To test the robustness of our results, we altered our definition of detachment from the workforce to two and four out of five weeks, respectively. In addition, we examined return to work (i.e. patients in employment and not receiving any social benefits) among patients, who were in employment 30 days prior to CABG.

Statistical analyses

Descriptive data were reported as frequencies and percentages or medians with interquartile range as appropriate. Baseline characteristics were summarized separately for age groups (18-45, 46-50, 51-55, and 56-60 years) and differences between age groups were tested by applying the chi-square test for categorical variables. Factors associated with return to the workforce one year after CABG were identified using logistic regression, adjusted for age, gender, income, education, status on living alone, urgency of CABG, prior PCI, comorbidities, hospital admissions within the first year post-discharge, and year of CABG. Patients who were not followed for one year due to emigration or death were set as detached from the workforce in the logistic regression analysis. Important interactions were tested by likelihood ratio test and found not significant unless otherwise stated. In addition, cumulative incidence curves were constructed to estimate time to return to the workforce and maintenance of workforce attachment while taking into account the competing risk of death. All statistical analyses were performed with SAS statistical software (SAS 9.4, SAS Institute, Cary, North Carolina, USA), and a two-sided p-value <0.05 was considered statistically significant.

Ethics

All patient data were anonymized so that individuals could not be identified. In Denmark, retrospective registry-based studies do not require ethical approval, and approval for this study was obtained by the Danish Data Protection Agency (No. 2007-58-0015; internal reference: *GEH-2014-014*, I-Suite no. 02732).

Results

A total of 32,258 patients underwent isolated CABG between January 1, 1998 and December 31, 2011, and 9548 patients (27.0%) were of working age between 18-60 years and alive at discharge (Supplementary Figure 1 for selection process). Of these, 6031 (63.2%) were part of the workforce 30 days prior to admission for CABG and comprised the study population (Supplementary Table 4 for employment status 30 days prior to CABG in patients of working age and alive at discharge). Baseline characteristics stratified according to age are summarized in Table 1. The median age of the study population was 55 (interquartile range 8) years and 88.9% were men. Patients aged 56-60 years comprised 43% of the study population. Younger patients (age 18-45) were more likely to undergo urgent and emergency surgery, had a lower proportion of men, less comorbidities, and more rehospitalizations within the first year post-discharge compared with older patients.

Return to the workforce following CABG

The distribution of outcomes every 6 months for a total of two years after discharge for CABG according to age is presented in Figure 1. One year after discharge, 4827 (80.0%) patients had returned to the workforce, 614 (10.2%) were on paid sick leave, 63 (1.0%) received support due to reduced working capabilities, 204 (3.4%) received disability pension, 250 (4.1%) were on early retirement, 57 (0.9%) had died, and 16 (0.3%) had emigrated. The proportion of patients returning to the workforce at one-year follow-up ranged from 75.6% to 84.2% and was lowest in the oldest age group. Mortality during one-year follow-up was low and comparable between all age groups ranging from 0.7% and 1.3%.

Figure 2 displays the distribution of outcomes at one-year follow-up in patients with and without significant comorbidities at discharge. 965 (16.0%) patients had significant comorbidities at discharge. Regardless of age, patients with significant comorbidities were less likely to return to the workforce compared with those without significant comorbidities, and the

difference was most pronounced in patients aged 18-45 years (84.5% without versus 69.0% with significant comorbidities). Likewise, mortality was higher among patients with significant comorbidities compared with those without significant comorbidities. Notably, patients aged 18-45 years with significant comorbidities had the highest one-year mortality (4.2%) compared with older patients.

Factors associated with return to the workforce

Results from the multivariate logistic regression for return to the workforce one year after discharge for CABG are shown in Figure 3. Factors associated with a higher likelihood of returning to the workforce were younger age, male sex, and higher level of education and income. Urgency of surgery, more hospital admissions within a year post-discharge, and a history of heart failure, stroke, atrial fibrillation, hypertension, chronic kidney disease, chronic obstructive pulmonary disease, and liver disease were associated with a lower likelihood of returning to the workforce.

Time to return to and maintenance of workforce attachment

We also calculated time to return to the workforce and maintenance of workforce attachment. During two years follow-up, 5524 (91.6%) patients returned to the workforce; of these, 83.6% had returned to the workforce 6 months after discharge for CABG (Supplementary Figure 2). Among patients who returned to the workforce for a minimum of three consecutive weeks, 37.2% were detached from the workforce within two years when no sick leave from the workforce was accepted. When sick leave up to three and 12 weeks was accepted, 31.2% and 25.0% were detached from the workforce within two years, respectively (Supplementary Figure 3).

Sensitivity analyses

We altered our definition of detachment from the workforce to two and four out of five weeks, respectively and found no difference in the proportion of patients returning to the workforce one year after discharge for CABG (79.6% and 80.6% for two and four weeks, respectively). In addition, we examined return to work (i.e. patients in actual employment and not receiving any social benefits) in patients, who were employed 30 days prior to CABG. The proportion of patients returning to work one year after discharge for CABG was similar as for patients returning to the workforce (78.1% versus 80.0%).

Discussion

In this nationwide cohort study, we examined return to the workforce in patients of working age undergoing isolated CABG. Our study yielded three major findings: First, one year after discharge for CABG, four out of five patients returned to the workforce, and mortality was less than 1%. Second, the proportion of patients attached to the workforce remained constant from one year to two years post-surgery in younger patients, but decreased in older patients. Third, younger age, male sex, and higher level of education and income were associated with a higher likelihood of returning to the workforce whereas urgent and emergency surgery, comorbidities, and additional hospital admissions within a year were associated with a lower likelihood of returning to the workforce.

Although traditionally evaluated outcomes such as morbidity and mortality do not provide a complete assessment of recovery after surgery, they still play an important role and are easily measured. In line with previous studies, we found a low mortality at one year after CABG in patients of working age.**(20, 31, 32)** The low mortality makes it important to pay more attention to "softer" and more patient-related outcomes concerning quality of life such as functional rehabilitation, mental aspects, and return to the workforce. In previous studies, rates of return to the workforce after CABG were rather conflicting, as these varied between 54% and 93%.**(12-20)** However, most of these studies were prone to selection bias, as they relied on self-reported

information, applied different definitions of return to work (i.e. whether patients had to be employed or merely part of the workforce), and were limited by a small number of patients. To our knowledge, this is the first study to examine return to the workforce following CABG in a large unselected cohort of patients on a nationwide scale. We found that 80% of patients, who were part of the workforce 30 days prior to CABG, returned to the workforce one year after discharge for surgery. Not only does employment hold important socioeconomic consequences for the patient and society, but also enhance recovery and life satisfaction by consolidating self-esteem, confidence, and social identity.(7-11) Interestingly, the most recent CABG guidelines have little to no focus on the importance of returning to work despite the major personal and economic costs to society of not returning to work.**(3, 33)** In order to prevent detachment from the workforce to the extent possible, a better understanding of the factors preventing returning to work after CABG is warranted. Such information is potentially of great importance as it may help to suggest whether more intensive rehabilitation, psychological, educational, or some other therapeutic intervention may enable a successful reintegration into the workforce. Few studies have examined the impact of cardiac rehabilitation programs and found that participation in such programs may increase the proportion of patients returning to the workforce.**(34-36)** Interventions that might impact patients' likelihood of returning to the workforce should be explored further in order to restore these as best possible and with a minimum of lost value for society.

Attachment to the workforce one year after CABG is highly dependent on the presence of comorbidities; the proportion of patients returning to the workforce was considerably lower if the patients had significant comorbidities at discharge. A history of heart failure, chronic kidney disease, and liver disease were strongly associated with a lower likelihood of returning to the workforce. Other non-cardiovascular comorbidities (i.e. diabetes and malignancy) were not associated with a lower likelihood of returning to the workforce, although there was a clear trend. Based on these

results, we could speculate that secondary prevention after CABG should not only be targeted towards cardiovascular comorbidities, but also non-cardiovascular factors in order to increase the rate of returning to the workforce. Thus, these findings may encourage a multidisciplinary approach in the postoperative management of patients undergoing CABG. On the other hand, it is important to note that the vast majority of the study population was free of significant comorbidities and even a considerable proportion of these patients failed to return to the workforce. We also found an association between higher level of education and average household income and a higher likelihood of returning to the workforce, which are in line with previous studies **(16, 17, 19)** and are as such not surprising; individuals with a higher level of education have more financial, social, and psychological resources and may have a less physically demanding job – factors which may facilitate a fast and successful reintegration into the workforce.**(37, 38)** In agreement with previous studies our results suggest that potential efforts in keeping patients in the workforce would be best targeted in groups of low income and low levels of education.

Strengths and limitations

The main strength of this study is the completeness of data in a nationwide unselected cohort of patients undergoing CABG followed in a real-world setting. Our study has several limitations that need to be acknowledged. Our results are based on the Danish healthcare and social systems providing social services for all residents whenever indicated regardless of socioeconomic or insurance status. Thus, translation of our findings to countries with more restricted access to these services may be hampered. We have no information on important clinical parameters (e.g. coronary lesions, **completeness of revascularization,(39)** left ventricular systolic function, and plasma creatinine levels), postoperative depression, presence of angina, participation in cardiac rehabilitation, or **the degree of physician teamwork.(40) These factors may be important**

determinants of the likelihood of returning to the workforce. We classified patients who emigrated within one year after discharge for CABG as detached from the workforce in the logistic regression analysis; most likely, this has little to no impact on our results, as only 0.3% of the study population emigrated. Although no patients could reach the state pension age during the two-year follow-up period, the oldest patients in the cohort did have an opportunity to retire early and receive early retirement benefits if the criteria for such benefits were met. It is not unlikely, that these patients, comprising 4.1% of the study population, may not return to the workforce due to lack of motivation and necessity rather than poor performance status.

Conclusion

We examined return to the workforce in patients of working age who were part of the workforce 30 days prior to CABG. One year after discharge for CABG, four of five patients returned to the workforce and mortality was low. A better understanding of the causes of not returning to the workforce is warranted and such information may suggest whether intensive rehabilitation, psychological, educational, or some other therapeutic intervention may enable a successful reintegration into the workforce for patients undergoing CABG.

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Figure Legends

Figure 1. Distribution of outcomes every 6 months for a total of two years in patients available to the workforce 30 days prior to CABG

Figure 2. Distribution of outcomes at one-year follow-up in patients available to the workforce 30 days prior to CABG with and without significant comorbidities

C, Significant comorbidities; NC, No significant comorbidities.

Significant comorbidities were defined as Charlson Comorbidity Index > 2 (N=1855) and no significant comorbidities as Charlson Comorbidity Index 0-2 (N=4486)

Figure 3. Results from the multivariable logistic regression examining factors associated with return to the workforce one year after discharge for CABG

PCI, Percutaneous coronary intervention; AMI, Acute myocardial infarction; COPD, Chronic obstructive pulmonary disease

Table 1. Baseline characteristics at discharge and hospital admissions within the first year of patients available to the workforce 30 days prior to CABG

Characteristics	Age 18-45 N=600	Age 46-50 N=950	Age 51-55 N=1886	Age 56-60 N=2595	P-value
Age (median [interquartile range])	43 (4)	48 (3)	53 (2)	58 (2)	
Male, N (%)	492 (82.0)	831 (87.5)	1670 (88.6)	2369 (91.3)	< 0.001
Income group					< 0.001
Q1 (lowest)	148 (24.7)	140 (14.7)	293 (15.5)	359 (13.8)	
Q2	142 (23.7)	203 (21.4)	415 (22.0)	644 (24.8)	
Q3	167 (27.8)	276 (29.1)	554 (29.4)	717 (27.6)	
Q4 (highest)	143 (23.8)	331 (34.8)	624 (33.1)	875 (33.7)	
Education					< 0.001
Basic school	189 (31.5)	253 (26.6)	521 (27.6)	767 (29.6)	
High school	29 (4.8)	37 (3.9)	57 (3.0)	66 (2.5)	
Vocational education	240 (40.0)	415 (43.7)	856 (45.4)	1164 (44.9)	
Short/medium higher education	68 (11.3)	141 (14.8)	270 (14.3)	400 (15.4)	
Long higher education	34 (5.7)	48 (5.1)	107 (5.7)	133 (5.1)	
Unknown	40 (6.7)	56 (5.9)	75 (4.0)	65 (2.5)	
Living alone	158 (26.3)	190 (20.0)	375 (19.9)	482 (18.6)	< 0.001
Surgery, N (%)					0.006
Elective	460 (76.7)	769 (81.0)	1542 (81.8)	2120 (81.7)	
Urgent	93 (15.5)	128 (13.5)	253 (13.4)	369 (14.2)	
Emergency	47 (7.8)	53 (5.6)	91 (4.8)	106 (4.1)	
Prior PCI, N (%)	158 (26.3)	215 (22.6)	407 (21.6)	484 (18.7)	< 0.001
Charlson Comorbidity Index					0.01
0-2	529 (88.2)	807 (85.0)	1581 (83.8)	2149 (82.8)	
> 2	71 (11.8)	143 (15.1)	305 (16.2)	446 (17.2)	
Comorbidities, N (%)					
Myocardial infarction	312 (52.0)	450 (47.4)	897 (47.6)	1277 (49.2)	0.21
Heart failure	56 (9.3)	102 (10.7)	172 (9.1)	270 (10.4)	0.40
Stroke	11 (1.8)	22 (2.3)	54 (2.9)	121 (4.7)	< 0.001
Atrial fibrillation	14 (2.3)	36 (3.8)	96 (5.1)	194 (7.5)	< 0.001
Hypertension	360 (60.0)	606 (63.8)	1213 (64.3)	1799 (69.3)	< 0.001
Diabetes	71 (11.8)	138 (14.5)	278 (14.7)	373 (14.4)	0.34

Peripheral vascular disease	12 (2.0)	23 (2.4)	69 (3.7)	116 (4.5)	0.003
Malignancy	5 (0.8)	20 (2.1)	57 (3.0)	68 (2.6)	0.02
Chronic renal failure	6 (1.0)	12 (1.3)	18 (1.0)	29 (1.1)	0.89
Chronic obstructive pulmonary disease	10 (1.7)	21 (2.2)	37 (2.0)	94 (3.6)	< 0.001
Liver disease	7 (1.2)	10 (1.1)	25 (1.3)	25 (1.0)	0.72
Concomitant medical treatment, N (%)					
Statins	489 (81.5)	777 (81.8)	1515 (80.3)	2084 (80.3)	0.71
Beta-blockers	508 (84.7)	826 (87.0)	1607 (85.2)	2228 (86.9)	0.54
Calcium-blockers	231 (38.5)	384 (40.4)	776 (41.2)	1097 (42.3)	0.35
Renin-angiotensin-system inhibitors	215 (35.8)	374 (39.4)	769 (40.8)	1138 (43.9)	< 0.001
Thiazides	56 (9.3)	95 (10.0)	253 (13.4)	419 (16.2)	< 0.001
Loop diuretics	91 (15.2)	170 (17.9)	337 (17.9)	545 (21.0)	0.002
Spironolactone	26 (4.3)	39 (4.1)	68 (3.6)	101 (3.9)	0.84
Clopidogrel	148 (24.7)	210 (22.1)	378 (20.0)	537 (20.7)	0.08
Acetylsalicylic acid	473 (78.8)	756 (79.6)	1472 (78.1)	2025 (78.0)	0.76
Oral anticoagulants	12 (2.0)	32 (3.4)	49 (2.6)	84 (3.2)	0.26
Hospital admissions within the first year after discharge					< 0.001
None	366 (61.0)	629 (66.2)	1266 (67.1)	1816 (70.0)	
1-2	181 (30.2)	273 (28.7)	530 (28.1)	651 (25.1)	
> 2	53 (8.8)	48 (5.1)	90 (4.8)	128 (4.9)	

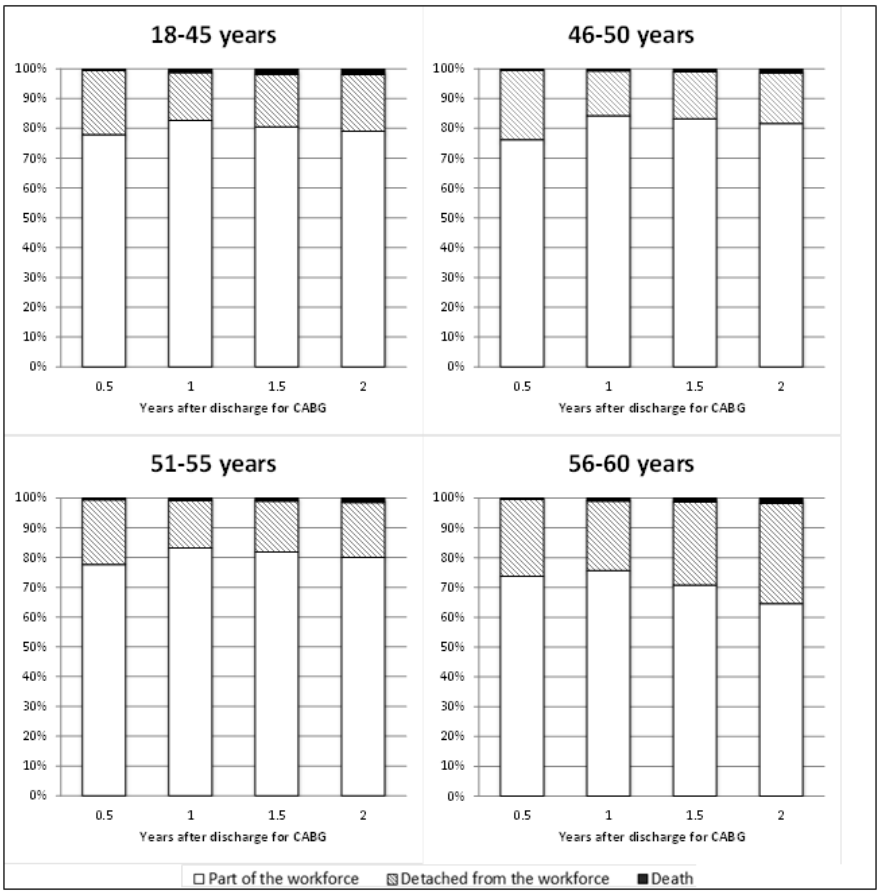

Figure 1

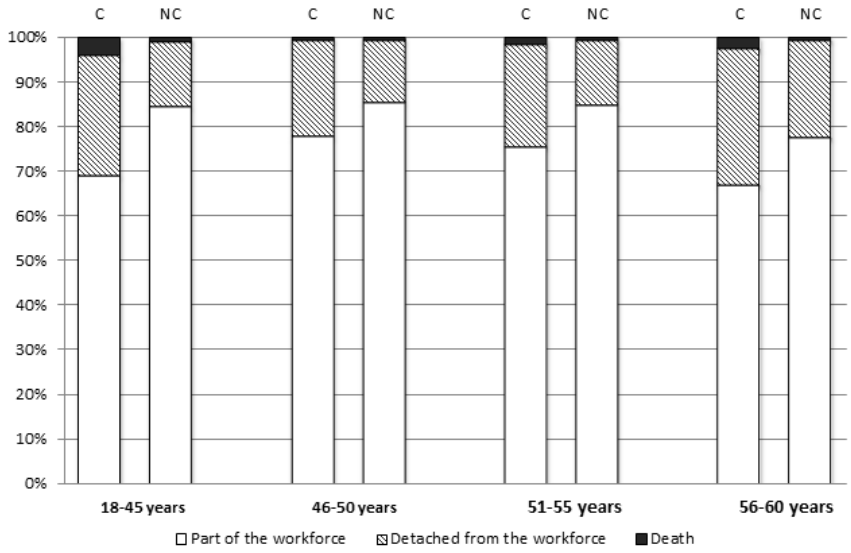

Figure 2

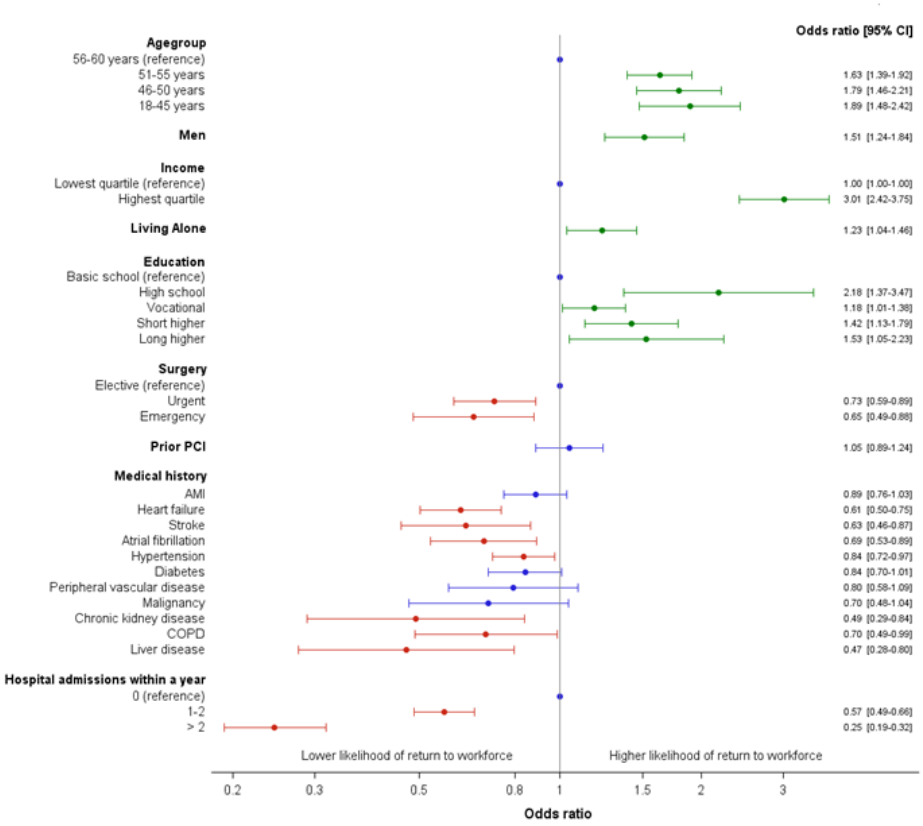

Figure 3